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the Equator itself is not a parallel of maximum heat. Sir David Brewster pointed out, as long ago as 1821, the probability of the thermometer being found to range ten degrees higher at the Pole than in some other parts of the Arctic circle, and this opinion has not been invalidated by any facts subsequently discovered. The summer climate must there be far more equable than that of the North Temperate zone, and although the polar winter may be correspondingly equable in its severity, it will be rather a prolonged evening than a six months night, owing to the moon, when at the full, never setting and the skies being irradiated by the Aurora borealis. The Paper concluded by a stirring appeal for the resumption of Arctic enterprise on the route attempted by Parry in his Spitzbergen voyage, showing how, with the advantages of steam-power and accumulated experience, the attainment of the Pole was not a matter of great difficulty even by the gunboats of Her Majesty's navy, two or three of which might annually be sent to cruise about on the edge of the pack, with orders to run in for the Polar Sea should an opening in the ring of pack-ice opportunely present itself.*

The second Paper was—

2. *On the best Route for North Polar Exploration.* By C. R. MARKHAM, Esq., Secretary R.G.S.

THE exploration of the North Polar Region is a great object—an object worthy of the advocacy of this Society—most worthy of achievement by England's navy. We are all agreed upon this point. Here there is no divergence of opinion. But there happen to be two roads to the Polar Region, and it is most important that their respective merits should receive full and careful consideration.

In selecting a route for North Polar Exploration it is above all things necessary that it should be one which offers a reasonable assurance of attaining numerous valuable scientific results, besides examining an extensive area in the direction of the Pole. It can be shown that the scheme of exploration proposed by Captain Sherard Osborn indisputably secures these ends; and I submit that no other should be substituted for it, unless it offers equal advantages.

The second route, that by the Spitzbergen Seas, is advocated by General Sabine, Sir Edward Belcher, Admiral Ommanney, and Captain Richards. It was originally proposed by the President of

* This Paper will be printed entire in the Journal.

the Royal Society, who, I believe, developed a plan for attempting it. It is intended to establish a base or dépôt in Spitzbergen, whence well-found screw-steamers may do battle with the pack to the northward, for two or three years if need be, until success is achieved.

In considering the merits of the Spitzbergen route we must reckon upon the Polar ocean being frozen over during the winter, except where the currents keep the ice in motion from time to time, and open such lanes and water-holes as are known to exist off the coast of Siberia in February.* The Gulf Stream, it is true, flows up between Spitzbergen and Nova Zembla, and comes out again as a cold Arctic current; but if it cannot melt the barrier of ice in the summer, it certainly will not cause the existence of a warm navigable ocean round the Pole during the winter. An argument in favour of a warm Polar climate has also been derived from the supposed influence of six months of unceasing sun-light. Scoresby long ago calculated that, at the summer solstice, the influence of the sun on the surface of the earth is greater at the Pole than at the Equator by nearly one quarter. But he points out that, on the same principle, the influence of the sun at 78° N. is only $\frac{1}{45}$ less than at the Pole, and also much greater than at the Equator. Now, at 78° N., the mean temperature of the year is 17° Fahr.: and ice is formed during nine months in the Spitzbergen seas, neither calm weather nor the proximity to land being essential to its formation. How then can the temperature further north be entirely different? It may readily be admitted that those parts of the

* Wrangell met with thin and broken ice at a distance of 20 miles from the Siberian coast in February, denoting open water, and the same water-holes were observed off the islands of New Siberia and Kotelnoi by Anjou. These *Polynias* of the Russians are equivalent to the *water-holes* of English Arctic nomenclature, such as are seen occasionally in May, and even in the depth of winter, in many parts of the Arctic Regions. They are caused by currents, and, in Baffin's Bay, also by movements of icebergs. It is absurd for a man standing on the ice, and seeing open water before him, to call it "an immeasurable ocean." He can only see, at the outside, a distance of a few miles.

When Barentz wintered in Nova Zembla in 1596, he saw open water to the northward in March, after a strong south-east gale. When it began to blow from the north-west, the ice returned again from that quarter. He naturally concluded, from this movement of the ice, that there must have been open water to the north, into which the ice was blown. Such open lanes and water-holes no doubt do exist through the winter, in the Polar ice, caused by currents, and the ice is thus kept in occasional motion by gales of wind. It is this condition of the ice which would cause the extreme danger of wintering in the Polar region north of 80° at a distance from any land. The ships would be kept in motion, and perhaps dashed about amongst heaving blocks of ice in a gale of wind, at a time of year when the incessant night and the intense cold render navigation impossible. The running rigging would be frozen too hard to reeve through the blocks, and the men would find it impossible to work aloft, while the seas would freeze hard as soon as they touched the deck.

Arctic zone where there is much land, such as Greenland and the vicinity of the magnetic pole, are much colder than portions where there is a wide expanse of ocean; but to suppose that this difference is so great as to affect the existence or non-existence of ice, is wholly inadmissible; even if the Polar pack did not yield a tangible proof that ice is formed round the Pole.

Young ice may be expected to form, so as to impede and eventually to stop navigation, early or late in September, according to the season. In the spring this ice begins to drift south, and continues to do so during summer and autumn; and the expedition taking the Spitzbergen route must force its way through it before the young ice begins to form—otherwise the season for exploration is lost.

The vital question now arises—what is the width and condition of this pack? Parry, in 1827, ascertained that it was at least 192 miles in extent, by walking over it; and at his extreme northern point in $82^{\circ} 45'$ a strong ice-blink was seen on the northern horizon, with a yellow tinge, which, according to Scoresby, denotes the presence of field-ice. This was in the end of July. We may, therefore, take its average width at that time to be about 250 miles. It may be much wider. This width no doubt varies in different years, according to the rate of southerly drift and the amount of rainfall.

Between Spitzbergen and Greenland it has usually been found to be closely packed, and Sir George Back has told us that Buchan, who examined it carefully both in June and September, found no lane by which to enter it. Phipps was equally unsuccessful. Between Spitzbergen and Nova Zembla the pack edge has also been examined by Barentz, Hudson, Wood, and Lutke. Hudson boldly attempted to enter it, but failed, and he examined its edge from the 9th to the 26th of June, when he reached the coast of Nova Zembla. Lutke also traced the line of the pack edge for a considerable distance, from Nova Zembla westward.

Still it is hoped that the Polar pack between Spitzbergen and Nova Zembla will be found loose and passable. This hope is based on the great advantage that steamers have over sailing-vessels, and on the presumed action of the Gulf Stream. It is certainly possible that, in a good season, an expedition may here enter the pack under favourable circumstances. All then depends on the time that it will take for vessels to force their way through it.* Let us see

* The analogy that has been attempted to be drawn between the pack in the Southern hemisphere through which Sir James Ross forced his way, and the Polar pack between Spitzbergen and Nova Zembla, is entirely delusive. The former was met with in 62° s. in the temperate zone, after having drifted, and become

upon what grounds we may calculate the probable length of this detention. The width of the Polar pack in the month of August is at least 250 miles, it may be much more; that of the middle pack in Baffin's Bay is generally about 172. Now the average detention in Baffin's Bay, calculating from the time taken by the six expeditions assisted by steam power (for we may now leave sailing-vessels out of the question), has been 22 days. But by holding on to the land-ice very little ground is ever lost in Baffin's Bay, and the existence of the land-floe makes eventual success almost a certainty, while between Spitzbergen and Nova Zembla there is a drifting pack with no fixed ice to assist navigation.

The expedition by the Spitzbergen route may, however, reasonably hope to bore its way through the drifting pack under fortunate circumstances, and how much depends on good luck all Arctic navigators know well, in 40 days, so that, if it takes the pack in July, it will reach open water to the northward, if such exists, and if the pack is only 250 miles wide, towards the end of August. If an attempt is made to take the pack earlier in the year, it will of course be much wider and closer, and the detention will be proportionally longer. There will then be about a fortnight left for North Polar Exploration, before the young ice begins to form. It must be remembered that dense fogs prevail in summer, wherever there is a large surface of open water in the Arctic regions. If a navigable sea exists, however, valuable discoveries will be made in the hydrography and marine fauna of the Polar area; but the generally admitted absence of land on that meridian precludes the idea of wintering in safety, and destroys all chance of obtaining many of the important scientific results which are expected from North Polar Exploration by Smith Sound. Some of the advocates of the Spitzbergen route speculate on the existence of land, but the whole argument in favour of that route is based on its supposed absence. This supposition is founded on the absence of icebergs and of any mud or débris on the ice.* The argument is perfectly sound, so far as it goes, but the whole plan depends on conjecture and uncertainty.

Now, contrast the arguments for the Spitzbergen route with those for the route by Smith Sound. This opening, discovered by Baffin in 1616, is the true portal which leads to North Polar discovery; and the Smith Sound route, or a system of exploration by sledge-

loose and broken, through hundreds of miles, in a boundless ocean extending without interruption all round the world, in that parallel: the latter is but a short distance from the place where it was formed, even late in the summer, and is in a confined sea, surrounded on all sides by continents.

* Parry found mud on the ice in 82° N.

travelling, is accordingly advocated by Admiral Wrangell, the explorer of the coast of Arctic Siberia, by Sir George Back, by Admiral Collinson, by Sir Leopold McClintock, the discoverer of the fate of Franklin, by Captain Sherard Osborn, to whose paper we all listened with so much pleasure and attention two months ago, by Captain Vesey Hamilton, and by myself.

We know that vessels, by sticking to the land-floe, can reach the "North Water" of Baffin's Bay if they start sufficiently early in the year. As for the whalers, there is not a single year, from 1817 to 1849, in which one or more did not get through; and in five of the years the whole fleet reached the "North Water" in June. Out of 38 exploring ships that have gone up Baffin's Bay since 1616, not one has been lost, and not one has failed to pass through when these conditions have been observed. The cases of the *North Star*, and of the *Fox* in her first season, have been alluded to, but both these vessels reached the ice too late in the year. Had they been at the edge of the ice early in June, instead of late in July and August, they would have succeeded. This is certain; for in 1849, the very year when the *North Star* failed in August, a whaler got into the "North Water" as early as the 12th of June. In a note appended to this paper, I have shown that it may be certainly counted upon that two screw-steamers of 60 horse-power will get through the middle pack in about 22 days, and reach the "North Water." When any Arctic officer objects to the Smith Sound route, on the ground of difficulty in passing through Melville Bay, it must always be borne in mind that *he*, the objector, succeeded in overcoming that difficulty.

The "North Water" means Smith Sound, for it always extends to the entrance of that great opening. Two gunboats, then, can calculate upon reaching Cape Isabella, where one will winter, while the other will push farther to the northward, by keeping on the western or weather-side, and carefully avoiding that lee-shore on which the *Advance* was embayed.* Captain Inglefield, from the entrance of Smith Sound, saw open water to the horizon, stretching through seven points of the compass; and that gallant officer fully concurred in all that was said when Captain Osborn's paper was read; adding, that "he believed it to be quite practicable to reach the Pole through that opening in the northern seas."†

The exhilarating and delightful work of charging the ice in Melville Bay, cutting docks, chasing bears, and shooting looms and

* See page 8 of Sherard Osborn's paper.

† See the discussion after the reading of Captain Osborn's paper, p. 25.

dovekeys, while in the enjoyment of some of the most lovely and striking scenery that can be met with on this earth, will be exchanged for an Arctic winter,* with its gorgeous skies, its genial fellowship, and its rounds of gaiety. Autumn depôts will have been laid out, and February will find the 120 officers and men full of enthusiasm, in high health, and ready for the hard, trying work of the travelling season. The march towards the Pole will then be commenced along the coast which stretches to the northward. This is the route originally recommended by Admiral Wrangell,† the great explorer of Arctic Siberia. It is the route so ably advocated by Sherard Osborn; and Captain Richards, who prefers the Spitzbergen route for other reasons, has most emphatically told us that Smith Sound is the best and surest way of reaching the Pole by sledges. From February to the end of April the ice is always firm and fit for travelling near the shore: so that any talk of open water and drifting ice from May to August is totally irrelevant. The distance from Cape Parry to the Pole and back is 1000 miles, and, at the rate of about 10 miles a day, starting early in February, the party will be back by the middle of May.

We know that, from the furthest point reached by Dr. Kane's steward, the land stretched away due north as far as the eye could reach; and Mr. Arrowsmith places Cape Parry in $81^{\circ} 56' N.$, or 484 miles from the Pole. Now, Sir Leopold McClintock says that, with the present knowledge of Arctic travelling, a single sledge, without depôts, could take 60 days' provisions, and travel over 600 miles.‡ Thus the furthest depôt need only be 184 miles north of Cape Parry; and there are strong grounds for believing that land, or at least off-lying islands, extend for that short distance at least. Give us only 184 miles of land north of Cape Parry, and a sledge-journey to the Pole is a matter of calculation, if performed during the winter and early spring. The discovery of the North Pole by this route does not depend upon a drifting treacherous pack, upon the opening or closing of leads through the ice in the right direction, or upon a theoretical Polar basin, as is the case in the Spitzbergen seas. By the Smith Sound route it is a certainty, so far as human calculation can make it so. Sir Leopold McClintock has brought the art of Arctic sledge-travelling to such perfection, that this may be affirmed with perfect truth. That great explorer, who has passed six winters and ten summers in the Arctic regions, and who has walked over

* For a complete reply to those who seek, in Dr. Kane's experience, for an objection to Smith Sound as a place for wintering, see Captain Osborn's paper, pp. 8 and 16 (*note*).

† See 'Journal of the Royal Geographical Society,' vol. xviii. p. 19 (1848).

‡ He adds that in a long journey of this kind men would beat dogs.

many thousands of miles, would go from Cape Parry to the North Pole and back with ease; and if any one supposes that he is so destitute of resource as to be stopped by a lane of water, all I can say is—they do not know him.

Much has been said about the impossibility of dragging heavy boats over the ice. All who are acquainted with McClintock's system of travelling know well that the idea of doing so would never enter his head. He would probably supply each sledge with a very light India-rubber boat, in the event of so very improbable a contingency as that open lanes of water would be met with, on this meridian, between February and April. Such obstacles would not stop him. If a great navigable ocean is arrived at during those months, then of course his progress will be arrested. But, at the same time, a great discovery will have been made, and his researches will be turned into other directions, leading to results of equal value and interest.

Captain Richards has told us that it will take 70 men and 7 sledges to push on the foremost sledge to the Pole (I think Sir Leopold McClintock would only require 5), but he added that nothing else of any sort can be done. Are then the remaining 50 officers and men to be doing nothing all this time? Are the *dépôt* parties, as they return, to remain idle? Assuredly not. The extended party will discover the North Pole, while the rest of the expedition is engaged in scientific observations, and in explorations in other directions. The northern side of the great glacier-bearing continent of Greenland will be carefully examined, as well as all the land to the westward. Is nothing, too, to be done during the second summer season? We may rely upon it that immense results will be ensured by the exertions of explorers wintering for two seasons in Smith Sound, that every branch of science will be enriched by their labours, and that, even if success is denied them in their endeavour to reach the Pole, their achievements will repay the expenses of the expedition a thousand-fold, add rich material to the store of human knowledge, and be a credit to the British nation.

The measurement of an arc of the meridian to the northward of 80°, is one of the great *desiderata* of science. This can only be done up Smith Sound. It is not a subject to be touched upon lightly; few people are fully aware of its difficulties, and of the extreme accuracy which is absolutely necessary in the observations. Still it is to be done. It alone would be worth the despatch of an expedition, and here alone can the work be performed. On Spitzbergen an arc may be measured from latitude 76° to 80°, while in Smith Sound one vessel will winter near Cape Isabella in 78°, and the

other near 82° . It has been suggested that valuable work may be done in Spitzbergen by the *depôt* party, while the exploring vessels are in the pack; but this is all beaten ground, visited by yachtsmen in the summer, and it is already occupied by a Swedish scientific expedition.

To sum up. The Spitzbergen route offers, in the event of success, a chance of reaching the Pole, and the opportunity of exploring the supposed Polar basin; but everything must be done very hastily during the brief navigable season. In the event of failure, and we must always be prepared for it, the vessels will have accomplished nothing. They will have been a month or two struggling in the pack, and will at last be drifted out again, or smashed to pieces. In 1863 a Russian expedition, commanded by Lieutenant Wrangel, consisting of two vessels, went up between Spitzbergen and Nova Zembla; the vessels were beset in the ice, and both were lost.

The Smith Sound route, on the other hand, offers the discovery of the North Pole, of the northern side of Greenland, of the land to the westward, and all the numerous results in every branch of science which have been expected from a North Polar Expedition. Moreover, the explorations will be made by sledges, and therefore carefully and thoroughly. In the event of failure in securing the main object, all the other results will be attained; so that, under any circumstances, good and useful work will be done.

By the Spitzbergen route there is the bare chance of doing little, by the Smith Sound route there is the certainty of doing much.

I think, therefore, that there ought to be no doubt as to the route by Smith Sound being the best. Then, again, the Smith Sound route will be absolutely safe, the vessel near Cape Isabella being within perfectly easy reach of the Danish settlement of Upernavik. I do not wish it to be supposed that there is no individual danger to those who may, or I should rather say who *have*, gallantly come forward to serve in a Polar expedition of discovery. On the contrary, it will be a service requiring great powers of endurance, courage, and self-reliance of a high order, and indomitable resolution. But it is the desire to overcome difficulties and dangers, and to emulate the deeds of former naval worthies, which induces men to volunteer for such service. Suffice it to say that the climate is the healthiest in the world, and that a retreat from Smith Sound to the Danish settlements in summer is perfectly easy and devoid of danger.

Of the safety of the Spitzbergen route so much cannot be said; but anxious as I am to see something done, I shall be the last to

dwell upon its dangers. I will merely repeat what a Greenland whaling skipper once said: "When you have hold of the land-ice—there you are! but when you are in the pack—where are you?"

The Smith Sound route, I maintain, is the one which offers results most worthy of this country. If the solution of the greatest geographical problem that remains to be solved, if the achievement of those discoveries in every branch of science which have been pointed out, are not considered worth the expenditure of so trifling a sum as will be required—an expenditure which would be richly and abundantly repaid—the character of the English people must be strangely altered. But, Sir, I am confident that, when the subject has received full and fair consideration, the public opinion of the country will approve the completion of North Polar discovery, and that the Government will bow to that decision. When it is remembered how beneficial are the indirect advantages invariably derived from voyages of discovery, an interest will be felt in them, even by men who do not personally appreciate their scientific results. I know this from letters that have been received from all quarters by Sherard Osborn and myself; I know it from the numerous volunteers that have come forward; I know it from the generous and cordial support which this great project has received from the whole daily and weekly press, with three exceptions. Let the result be what it may, you, Sir, and the Fellows of this Society, will have the satisfaction of feeling that you have done your best to promote a great national undertaking, which, if not done by this generation, will assuredly be achieved by the next.

I only wish that Sherard Osborn could have been here to perform a task which I have so unworthily attempted; and, Sir, I cannot conclude without expressing my deep regret that we are at this time deprived of the advice and co-operation of that greatest of all living Arctic explorers, the discoverer of the fate of Franklin—Sir Leopold McClintock.

After the reading of the papers, the PRESIDENT thus addressed the Meeting:—

"For the third time during this Session your attention has now been called to the subject of a North Polar Expedition. When this subject was first brought before you by our gallant associate, Captain Sherard Osborn, a hearty desire animated all those who took part in the discussion to foster an enterprise so calculated to advance geography and the kindred branches of science; and no one of our experienced Arctic officers doubted the possibility of the project, whether carried out by the route of Smith Sound and the west coast of Greenland, or by that of Spitzbergen, as advocated by Dr. Petermann, and previously by General Sabine. At the following Meeting we were chiefly occupied in obtaining the opinions of those experienced navigators as to the